FIG. 1

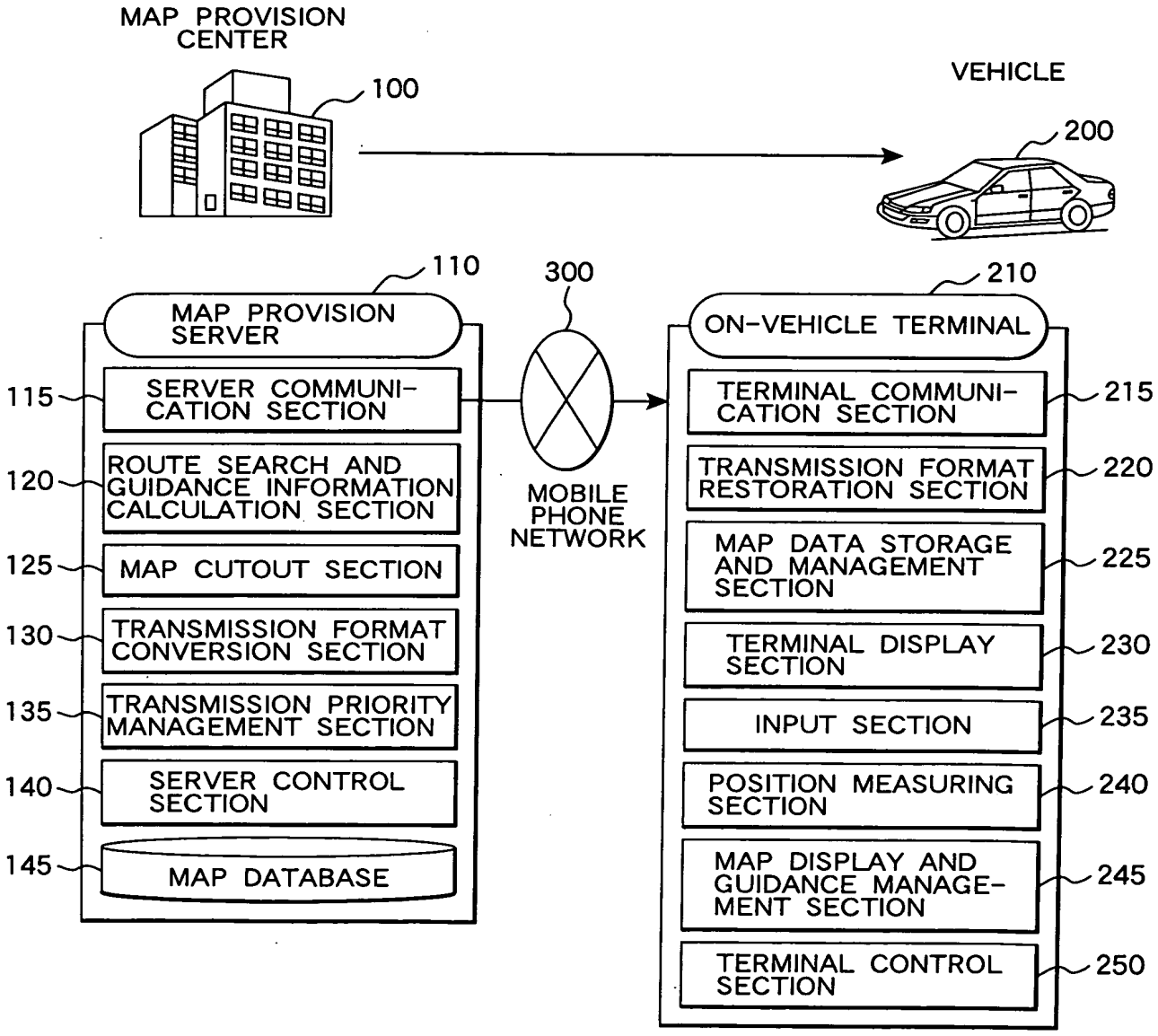

MAP PROVISION CENTER
100
VEHICLE
200
110
MAP PROVISION SERVER
115
SERVER COMMUNICATION SECTION
120
ROUTE SEARCH AND GUIDANCE INFORMATION CALCULATION SECTION
125
MAP CUTOUT SECTION
130
TRANSMISSION FORMAT CONVERSION SECTION
135
TRANSMISSION PRIORITY MANAGEMENT SECTION
140
SERVER CONTROL SECTION
145
MAP DATABASE
300
MOBILE PHONE NETWORK
210
ON-VEHICLE TERMINAL
TERMINAL COMMUNICATION SECTION
215
TRANSMISSION FORMAT RESTORATION SECTION
220
MAP DATA STORAGE AND MANAGEMENT SECTION
225
TERMINAL DISPLAY SECTION
230
INPUT SECTION
235
POSITION MEASURING SECTION
240
MAP DISPLAY AND GUIDANCE MANAGEMENT SECTION
245
TERMINAL CONTROL SECTION
250

FIG. 2

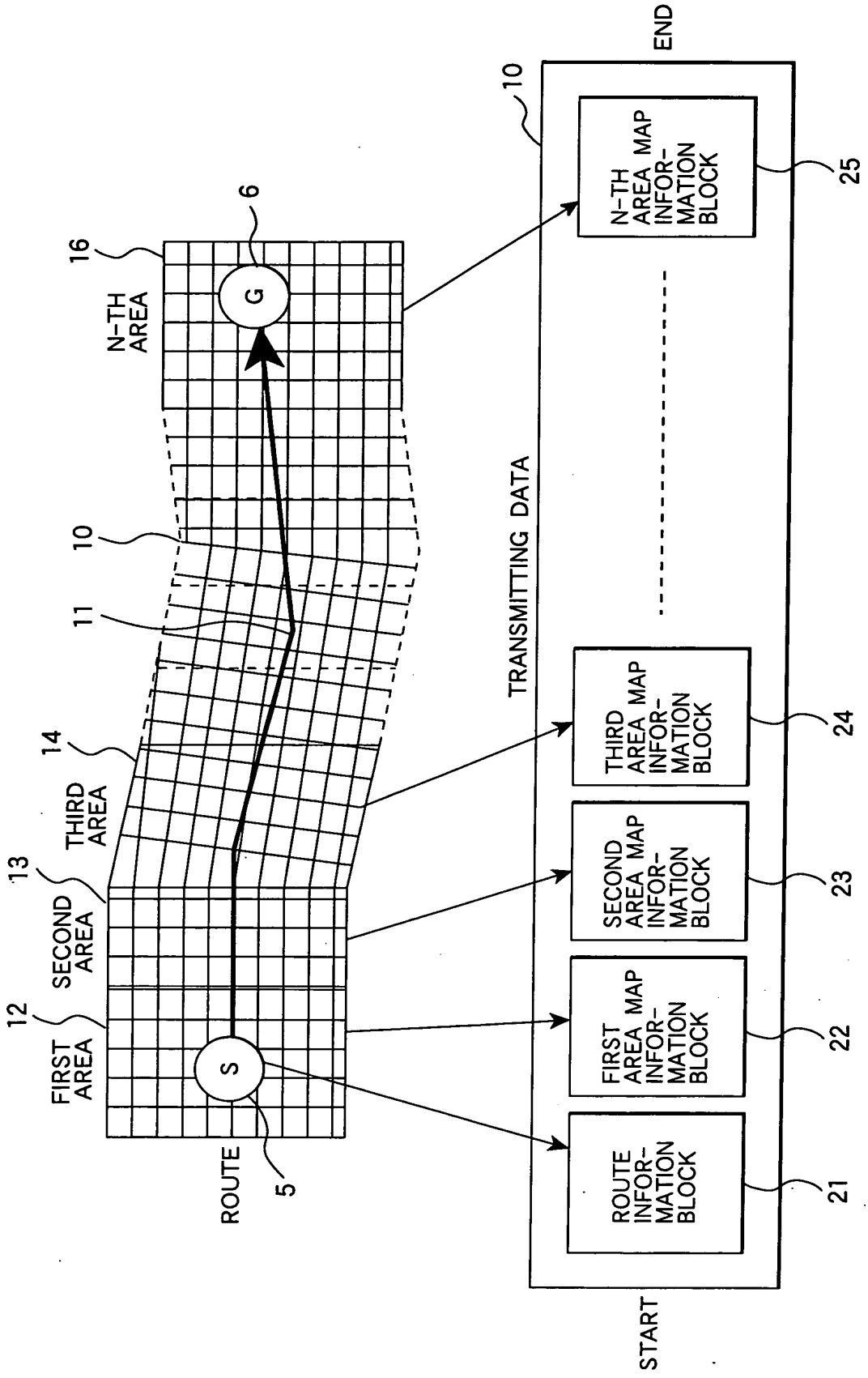

START
END
TRANSMITTING DATA
10
ROUTE INFOR-MATION BLOCK
21
FIRST AREA MAP INFOR-MATION BLOCK
22
SECOND AREA MAP INFOR-MATION BLOCK
23
THIRD AREA MAP INFOR-MATION BLOCK
24
N-TH AREA MAP INFOR-MATION BLOCK
25
ROUTE
5
S
G
6
FIRST AREA
12
SECOND AREA
13
THIRD AREA
14
11
10
N-TH AREA
16

FIG. 3

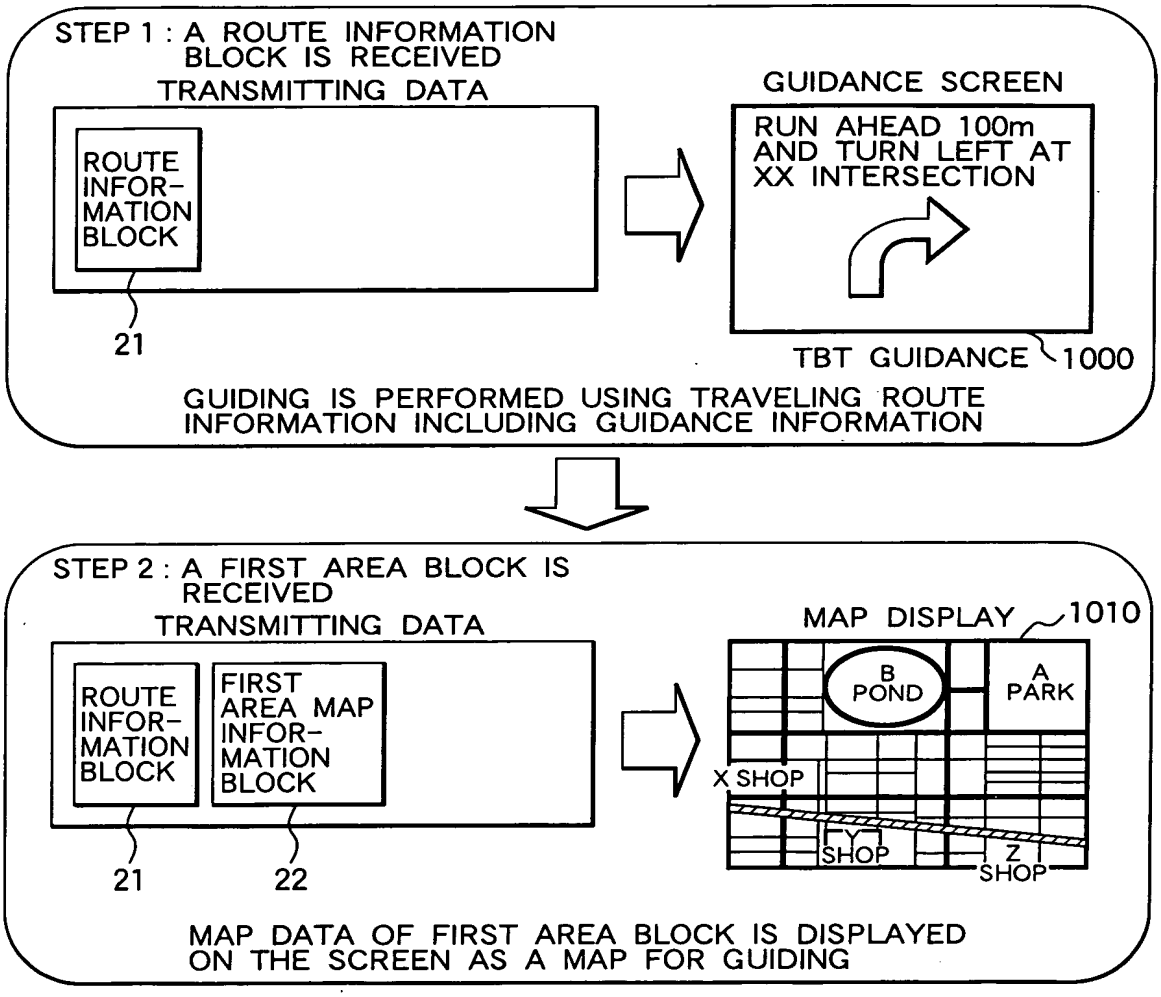

STEP 1 : A ROUTE INFORMATION BLOCK IS RECEIVED
TRANSMITTING DATA
ROUTE INFOR-MATION BLOCK
21
GUIDANCE SCREEN
RUN AHEAD 100m AND TURN LEFT AT XX INTERSECTION
TBT GUIDANCE
1000
GUIDING IS PERFORMED USING TRAVELING ROUTE INFORMATION INCLUDING GUIDANCE INFORMATION
STEP 2 : A FIRST AREA BLOCK IS RECEIVED
TRANSMITTING DATA
ROUTE INFOR-MATION BLOCK
FIRST AREA MAP INFOR-MATION BLOCK
21
22
MAP DISPLAY
1010
B POND
A PARK
X SHOP
Y SHOP
Z SHOP
MAP DATA OF FIRST AREA BLOCK IS DISPLAYED ON THE SCREEN AS A MAP FOR GUIDING

FIG. 4

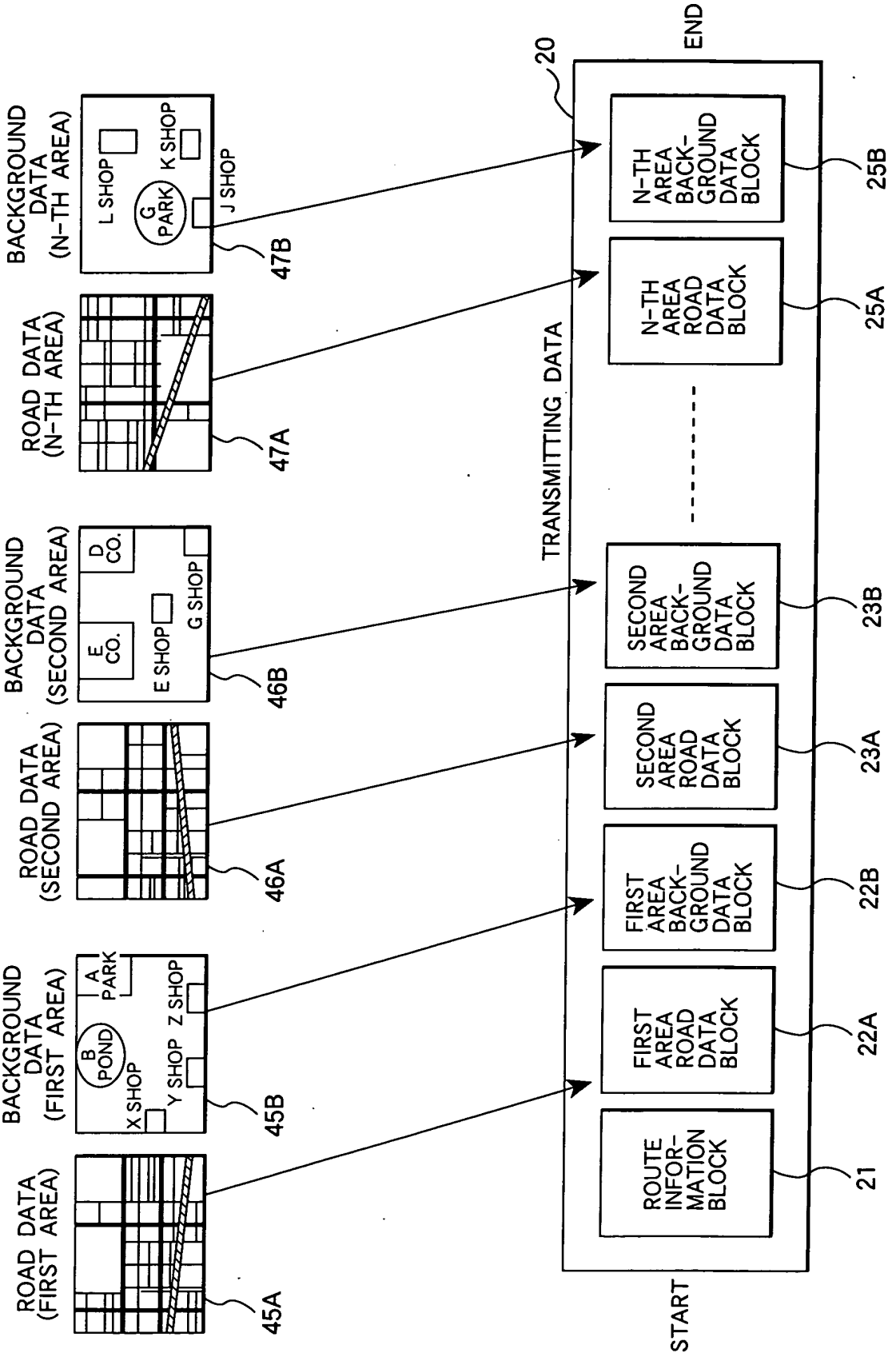

START
END
TRANSMITTING DATA
20
ROUTE INFOR-MATION BLOCK
21
FIRST AREA ROAD DATA BLOCK
22A
FIRST AREA BACK-GROUND DATA BLOCK
22B
SECOND AREA ROAD DATA BLOCK
23A
SECOND AREA BACK-GROUND DATA BLOCK
23B
N-TH AREA ROAD DATA BLOCK
25A
N-TH AREA BACK-GROUND DATA BLOCK
25B
ROAD DATA (FIRST AREA)
45A
BACKGROUND DATA (FIRST AREA)
45B
X SHOP
B POND
Y SHOP
Z SHOP
A PARK
ROAD DATA (SECOND AREA)
46A
BACKGROUND DATA (SECOND AREA)
46B
E CO.
E SHOP
G SHOP
D CO.
ROAD DATA (N-TH AREA)
47A
BACKGROUND DATA (N-TH AREA)
47B
L SHOP
G PARK
K SHOP
J SHOP

FIG. 5

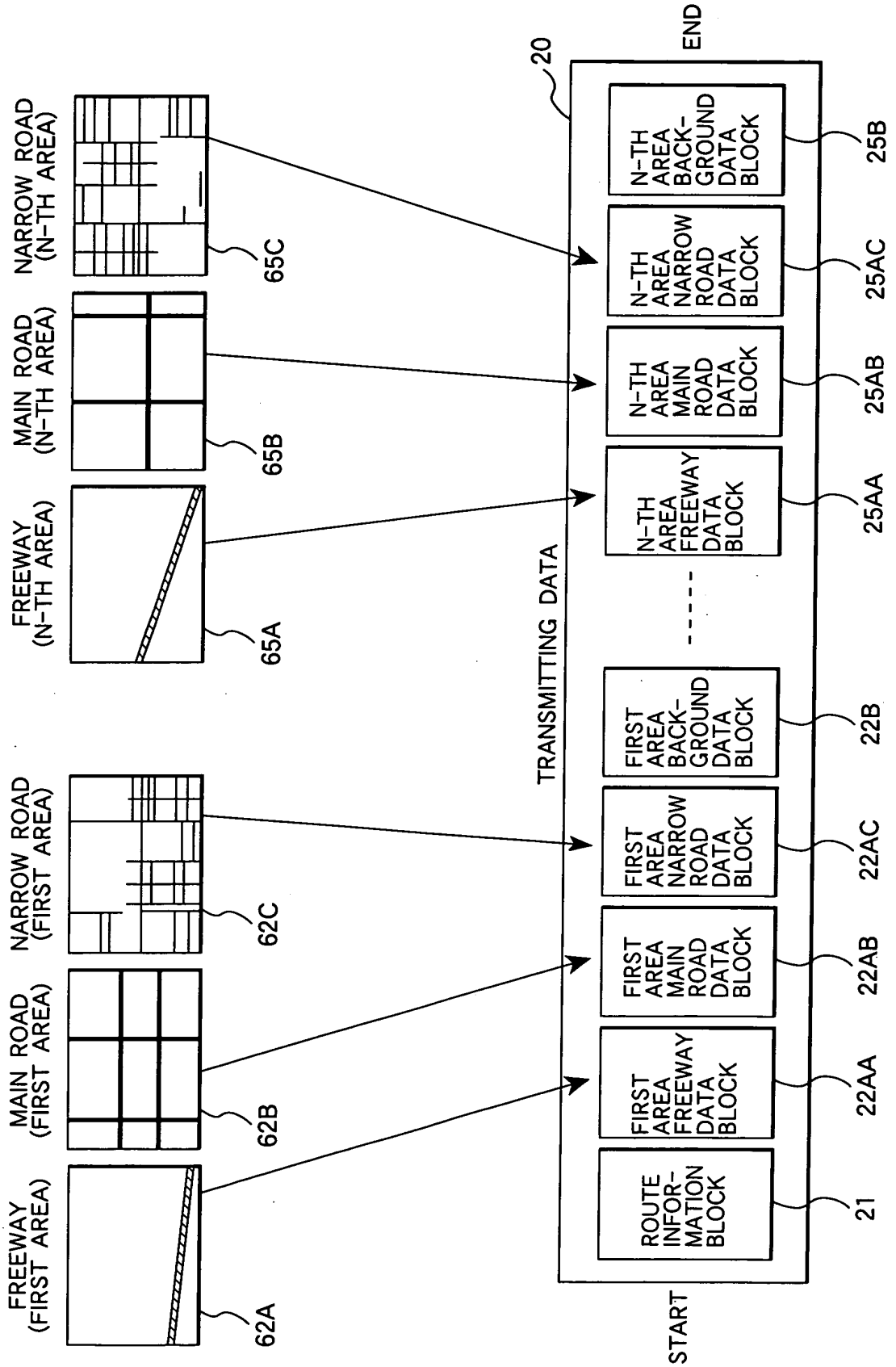

START
END
20
TRANSMITTING DATA
ROUTE INFOR-MATION BLOCK
21
FIRST AREA FREEWAY DATA BLOCK
22AA
FIRST AREA MAIN ROAD DATA BLOCK
22AB
FIRST AREA NARROW ROAD DATA BLOCK
22AC
FIRST AREA BACK-GROUND DATA BLOCK
22B
N-TH AREA FREEWAY DATA BLOCK
25AA
N-TH AREA MAIN ROAD DATA BLOCK
25AB
N-TH AREA NARROW ROAD DATA BLOCK
25AC
N-TH AREA BACK-GROUND DATA BLOCK
25B
FREEWAY (FIRST AREA)
62A
MAIN ROAD (FIRST AREA)
62B
NARROW ROAD (FIRST AREA)
62C
FREEWAY (N-TH AREA)
65A
MAIN ROAD (N-TH AREA)
65B
NARROW ROAD (N-TH AREA)
65C

FIG. 6

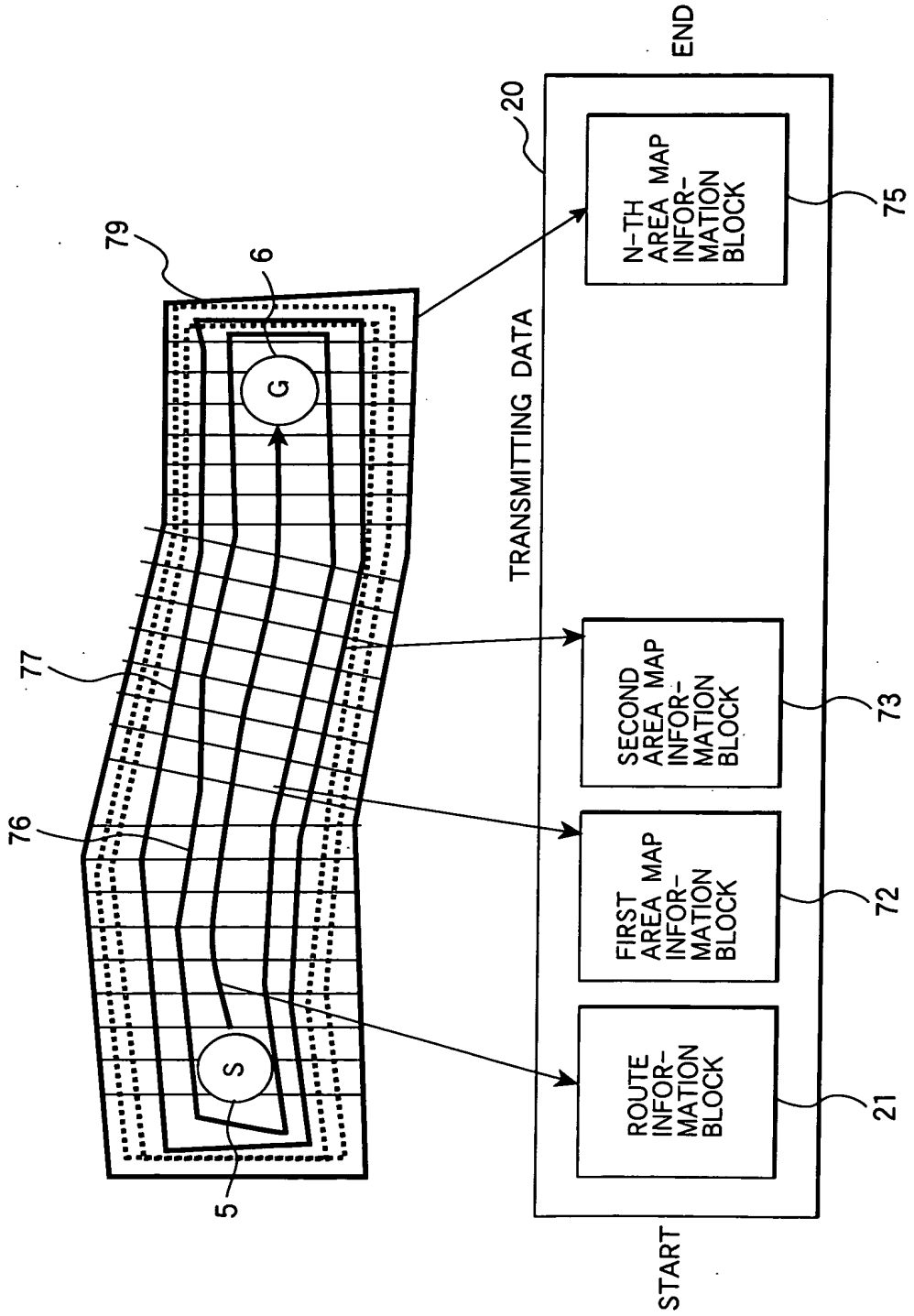

START
END
TRANSMITTING DATA
20
ROUTE INFOR-MATION BLOCK
21
FIRST AREA MAP INFOR-MATION BLOCK
72
SECOND AREA MAP INFOR-MATION BLOCK
73
N-TH AREA MAP INFOR-MATION BLOCK
75
S
G
5
6
76
77
79

FIG. 7

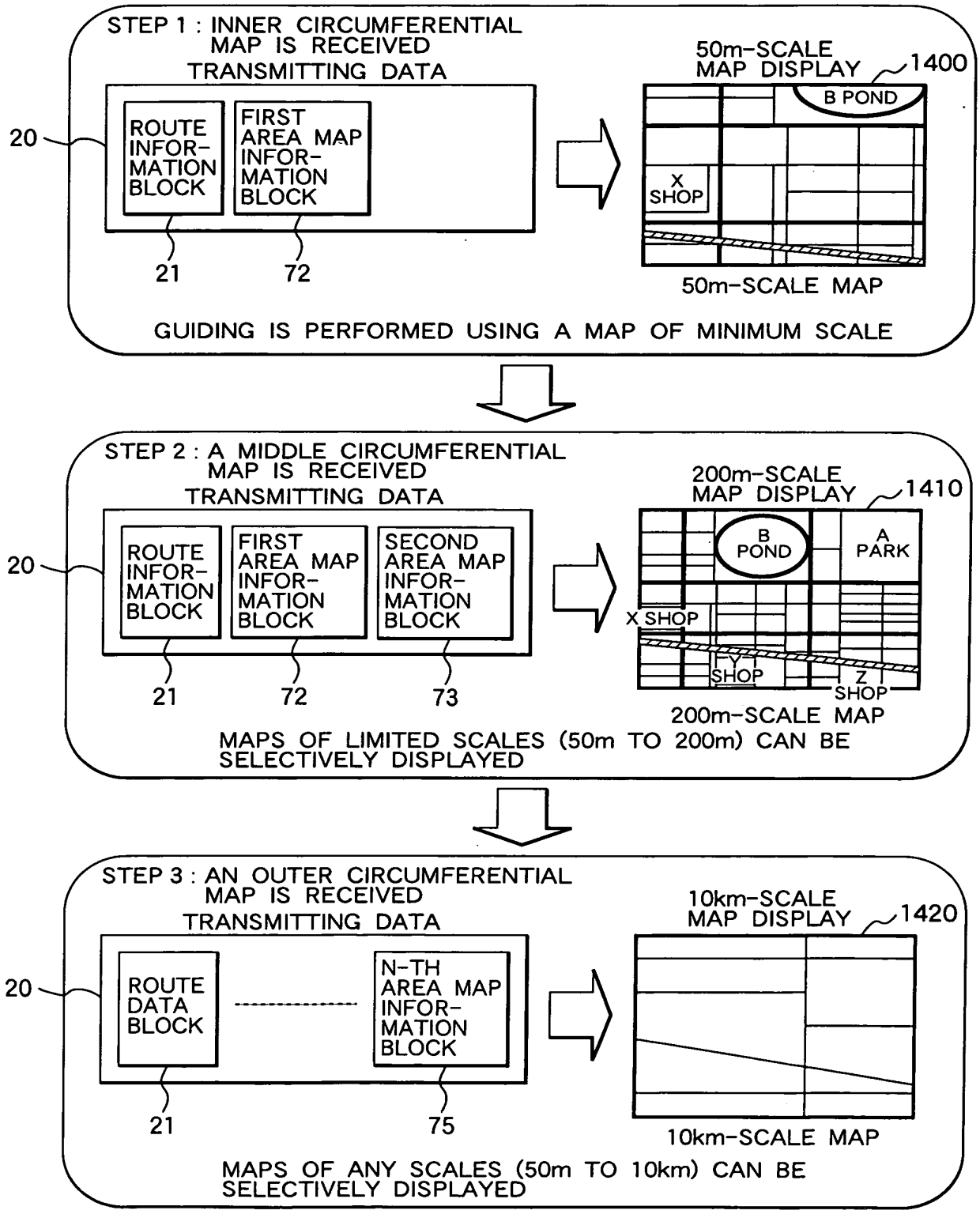

STEP 1 : INNER CIRCUMFERENTIAL MAP IS RECEIVED
TRANSMITTING DATA
20
ROUTE INFOR-MATION BLOCK
FIRST AREA MAP INFOR-MATION BLOCK
21
72
50m-SCALE MAP DISPLAY
1400
B POND
X SHOP
50m-SCALE MAP
GUIDING IS PERFORMED USING A MAP OF MINIMUM SCALE
STEP 2 : A MIDDLE CIRCUMFERENTIAL MAP IS RECEIVED
TRANSMITTING DATA
20
ROUTE INFOR-MATION BLOCK
FIRST AREA MAP INFOR-MATION BLOCK
SECOND AREA MAP INFOR-MATION BLOCK
21
72
73
200m-SCALE MAP DISPLAY
1410
B POND
A PARK
X SHOP
Y SHOP
Z SHOP
200m-SCALE MAP
MAPS OF LIMITED SCALES (50m TO 200m) CAN BE SELECTIVELY DISPLAYED
STEP 3 : AN OUTER CIRCUMFERENTIAL MAP IS RECEIVED
TRANSMITTING DATA
20
ROUTE DATA BLOCK
N-TH AREA MAP INFOR-MATION BLOCK
21
75
10km-SCALE MAP DISPLAY
1420
10km-SCALE MAP
MAPS OF ANY SCALES (50m TO 10km) CAN BE SELECTIVELY DISPLAYED

FIG. 8

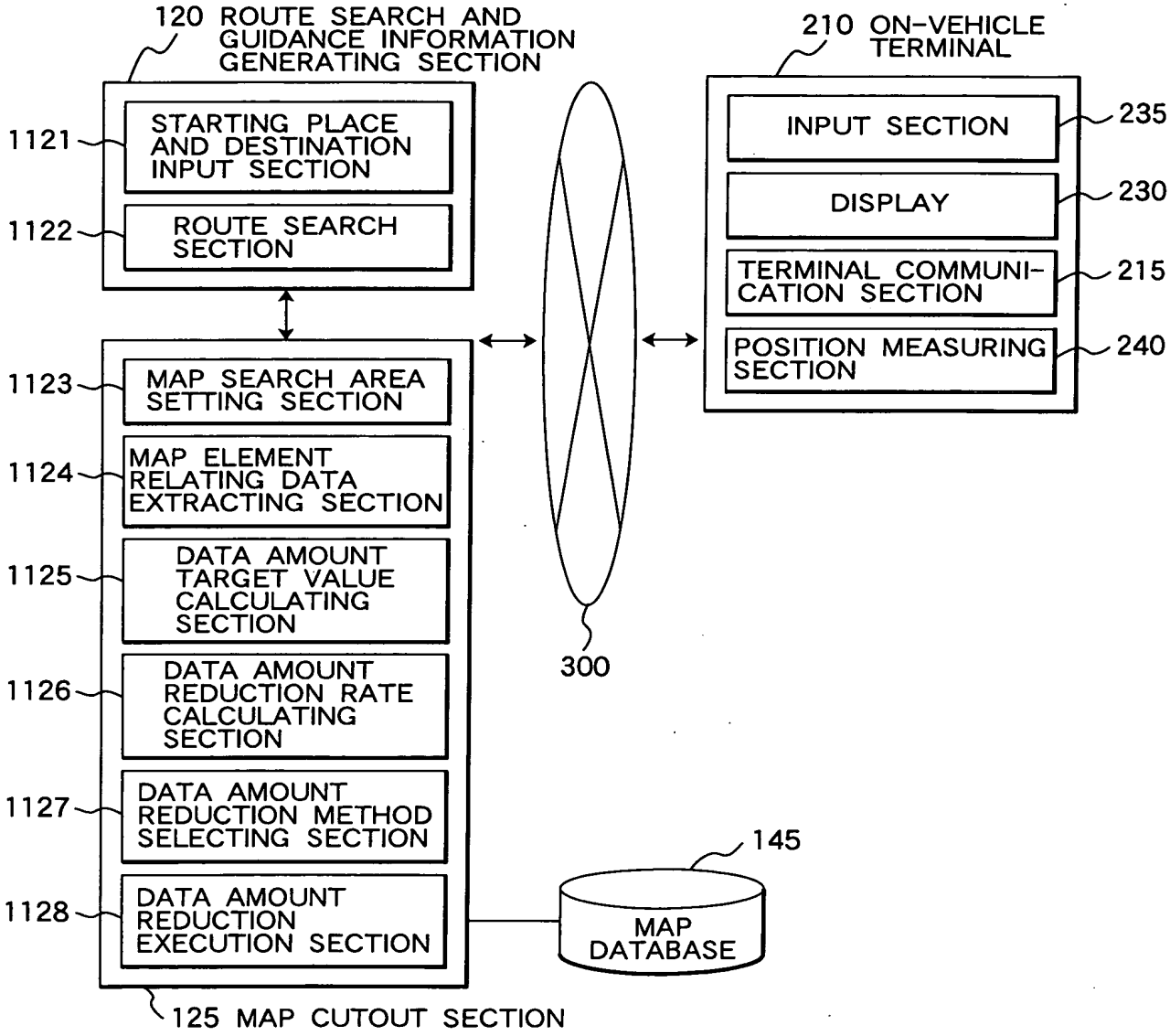

120 ROUTE SEARCH AND GUIDANCE INFORMATION GENERATING SECTION
1121
STARTING PLACE AND DESTINATION INPUT SECTION
1122
ROUTE SEARCH SECTION
1123
MAP SEARCH AREA SETTING SECTION
1124
MAP ELEMENT RELATING DATA EXTRACTING SECTION
1125
DATA AMOUNT TARGET VALUE CALCULATING SECTION
1126
DATA AMOUNT REDUCTION RATE CALCULATING SECTION
1127
DATA AMOUNT REDUCTION METHOD SELECTING SECTION
1128
DATA AMOUNT REDUCTION EXECUTION SECTION
125 MAP CUTOUT SECTION
300
210 ON-VEHICLE TERMINAL
INPUT SECTION
235
DISPLAY
230
TERMINAL COMMUNICATION SECTION
215
POSITION MEASURING SECTION
240
145
MAP DATABASE

FIG. 9

MAP DATABASE TABLE 301

ID	LAYER	CATEGORY	FIGURE TYPE	FIGURE DATA	NAME
2001	200	10	polyline	{(x1, y1), ···, (xn, yn)}	"CHUO LINE"
3002	300	20	polygon	{(x1, y1), ···, (xn, yn)}	"GREEN PARK"
1003	100	20	polyline	{(x1, y1), ···, (xn, yn)}	"ROUTE 16"
4004	400	10	point	(x1, y1)	"XX BANK"
⋮	⋮	⋮	⋮	⋮	⋮

LAYER TABLE 302

LAYER	CATEGORY TABLE NAME
100	ROAD
200	RAILWAY
300	FIELD
400	LANDMARK
⋮	⋮

ROAD CATEGORY TABLE 303

CATEGORY	CONTENT
10	EXPRESSWAY
20	NATIONAL ROAD
30	PREFECTURAL ROAD
40	REGULAR ROAD
⋮	⋮

RAILWAY CATEGORY TABLE 304

CATEGORY	CONTENT
10	JR
20	PRIVATE RAILWAY
30	SUBWAY
40	MONORAIL
⋮	⋮

FIELD CATEGORY TABLE 305

CATEGORY	CONTENT
10	WATERS
20	PARK
30	SEA
40	OTHERS
⋮	⋮

LANDMARK CATEGORY TABLE 306

CATEGORY	CONTENT
10	BANK
20	RESTAURANT
30	DEPARTMENT STORE
40	FAST FOOD
⋮	⋮

FIG. 10

401

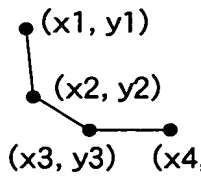
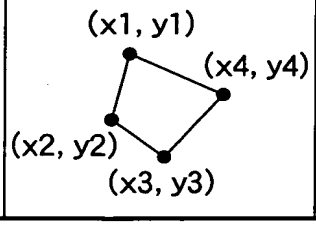
FIGURE TYPE	EXAMPLE OF FIGURE DATA	STORAGE FORM
point	(x, y)	(x, y)
polyline	 (x1, y1) (x2, y2) (x3, y3) (x4, y4)	{(x1, y1),(x2, y2),(x3, y3),(x4, y4)}
polygon	 (x1, y1) (x4, y4) (x2, y2) (x3, y3)	{(x1, y1),(x2, y2),(x3, y3),(x4, y4)}

FIG. 11

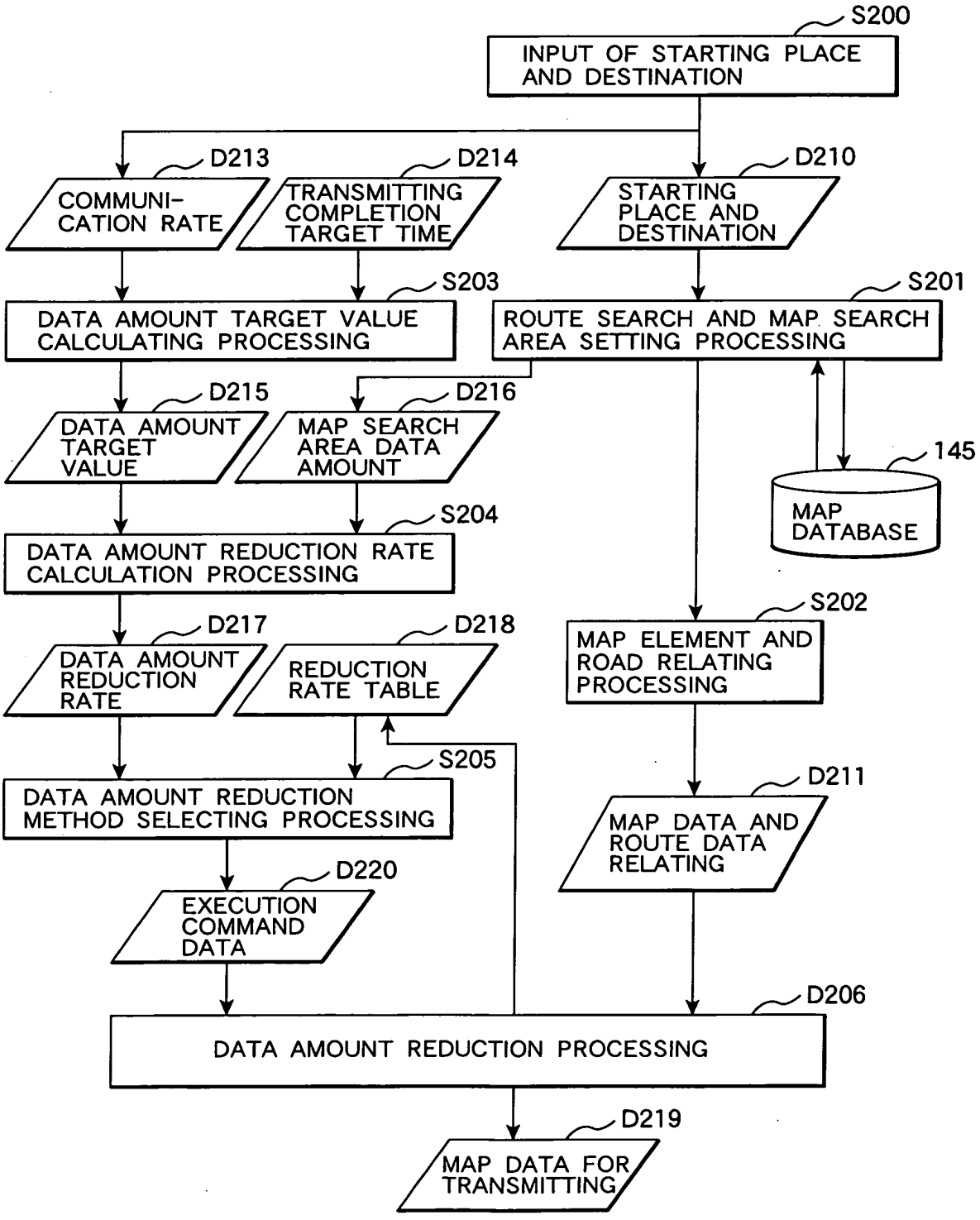

S200
INPUT OF STARTING PLACE AND DESTINATION
D213
COMMUNI-CATION RATE
D214
TRANSMITTING COMPLETION TARGET TIME
D210
STARTING PLACE AND DESTINATION
S203
DATA AMOUNT TARGET VALUE CALCULATING PROCESSING
S201
ROUTE SEARCH AND MAP SEARCH AREA SETTING PROCESSING
D215
DATA AMOUNT TARGET VALUE
D216
MAP SEARCH AREA DATA AMOUNT
145
MAP DATABASE
S204
DATA AMOUNT REDUCTION RATE CALCULATION PROCESSING
S202
MAP ELEMENT AND ROAD RELATING PROCESSING
D217
DATA AMOUNT REDUCTION RATE
D218
REDUCTION RATE TABLE
S205
DATA AMOUNT REDUCTION METHOD SELECTING PROCESSING
D211
MAP DATA AND ROUTE DATA RELATING
D220
EXECUTION COMMAND DATA
D206
DATA AMOUNT REDUCTION PROCESSING
D219
MAP DATA FOR TRANSMITTING

FIG. 12

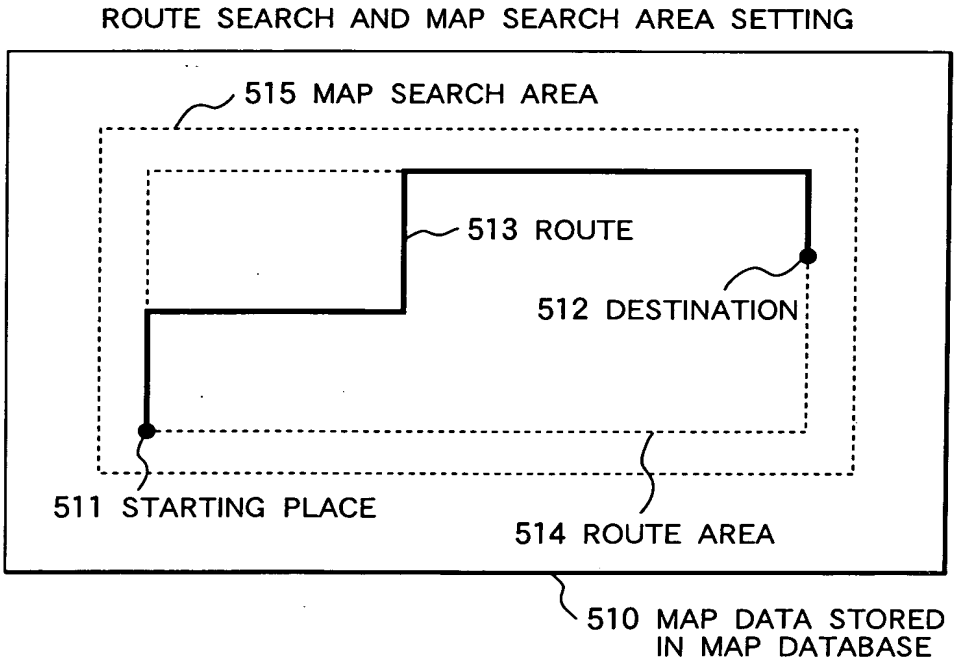
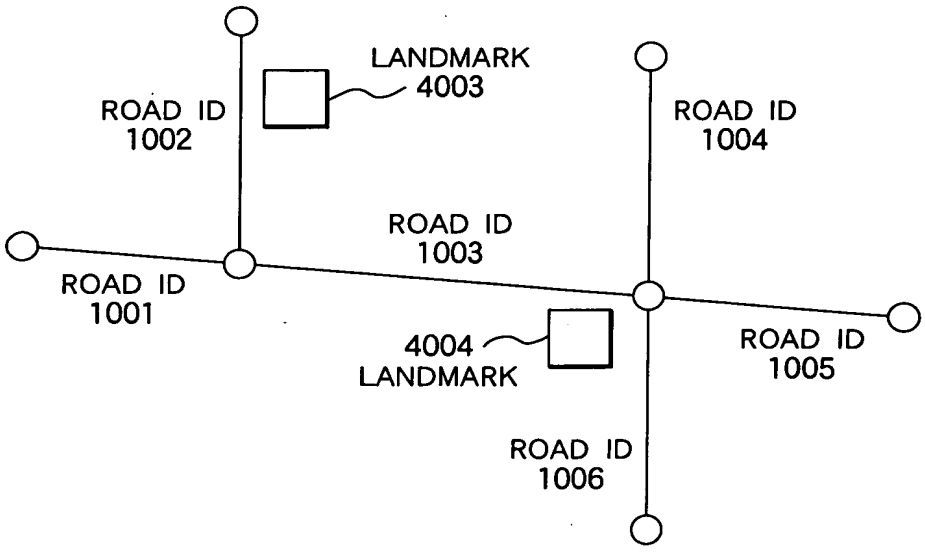

ROUTE SEARCH AND MAP SEARCH AREA SETTING
515 MAP SEARCH AREA
513 ROUTE
512 DESTINATION
511 STARTING PLACE
514 ROUTE AREA
510 MAP DATA STORED IN MAP DATABASE

FIG. 13

RELATING LANDMAK FIGURES AND ROADS

301 601

ID	LAYER	CATEGORY	FIGURE TYPE	FIGURE DATA	NAME	ADJACENT ROAD
4003	400	20	point	(x1, y1)	""	{1002}
4004	400	10	point	(x1, y1)	"XX BANK"	{1003, 1006}
⋮	⋮	⋮	⋮	⋮	⋮	⋮



ADJACENT ROAD IDS ARE FOUND AND RELATED IN UNITS OF FIGURES

: ROAD

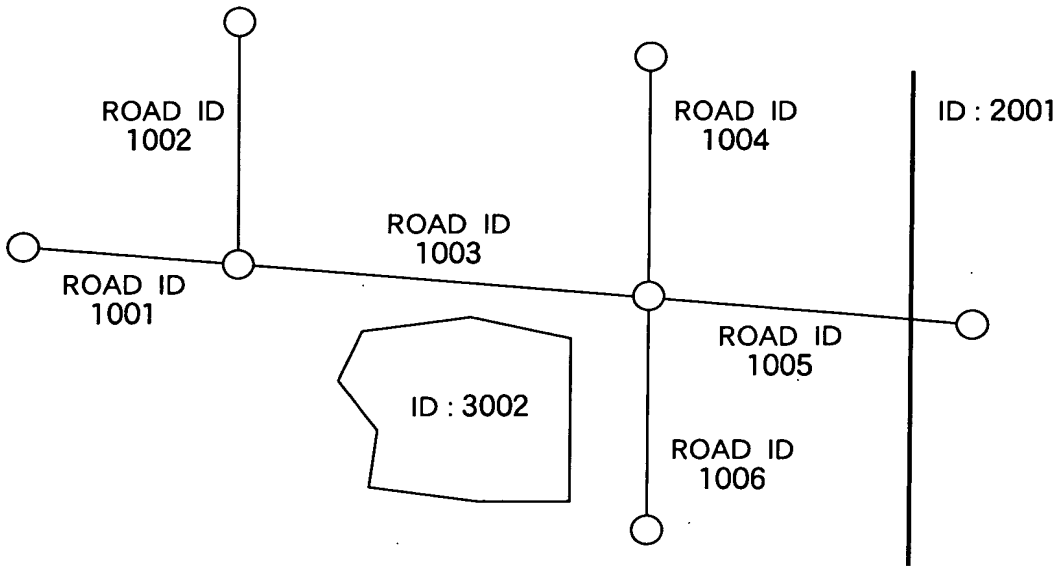
: INTERSECTION

: LANDMARK

FIG. 14

RELATING BACKGROUND FIGURES AND ROADS 301 701

ID	LAYER	CATEGORY	FIGURE TYPE	FIGURE DATA	NAME	ADJACENT ROAD
2001	200	10	polyline	{(x1, y1), . . . }	"CHUO LINE"	{1002}
3002	300	20	polyline	{(x1, y1), . . . }	"GREEN PARK"	{1003, 1006}
⋮	⋮	⋮	⋮	⋮	⋮	⋮



ADJACENT OR INTERSECTING ROAD IDS ARE FOUND AND RELATED IN UNITS OF FIGURES

FIG. 15

REDUCTION RATE TABLE 803

DATA REDUCTION METHOD NAME	PARAMETER SET	REDUCTION RATE (%)
ROAD/BACKGROUND/LANDMARK FIGURE SELECTING 1	a	80
ROAD/BACKGROUND/LANDMARK FIGURE SELECTING 2	b	60
ROAD/BACKGROUND/LANDMARK FIGURE SELECTING 3	c	40
FIRST POLYLINE FIGURE LINEARIZING PROCESSING	FIXED	5
POLYLINE FIGURE INTEGRATING PROCESSING	FIXED	15
⋮	⋮	⋮

804

PARAMETER TYPE OF ROAD FIGURE SELECTING PROCESSING

a : ONLY ROUTES AND ROUTE MINOR ROADS INTERSECTING WITH THE ROUTES ARE SELECTED

b : ONLY ROUTES, MAIN ROADS, AND ROUTE MINOR ROADS ARE SELECTED

c : ROUTES, MAIN ROADS, AND ROUTE MINORS, AND STRAIGHT CONNECTING ROADS ARE SELECTED

FIG. 16

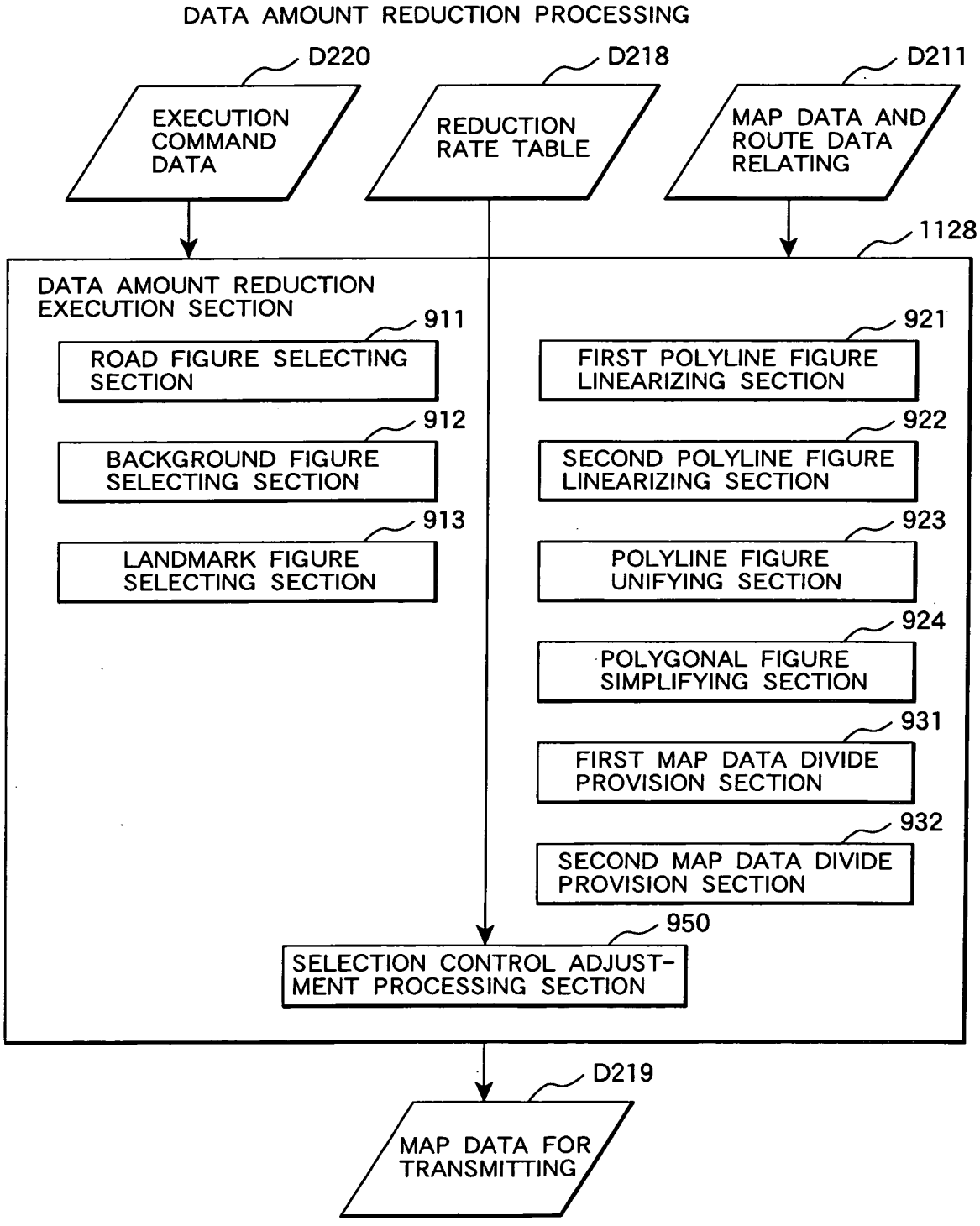

DATA AMOUNT REDUCTION PROCESSING
D220
EXECUTION COMMAND DATA
D218
REDUCTION RATE TABLE
D211
MAP DATA AND ROUTE DATA RELATING
1128
DATA AMOUNT REDUCTION EXECUTION SECTION
911
ROAD FIGURE SELECTING SECTION
912
BACKGROUND FIGURE SELECTING SECTION
913
LANDMARK FIGURE SELECTING SECTION
921
FIRST POLYLINE FIGURE LINEARIZING SECTION
922
SECOND POLYLINE FIGURE LINEARIZING SECTION
923
POLYLINE FIGURE UNIFYING SECTION
924
POLYGONAL FIGURE SIMPLIFYING SECTION
931
FIRST MAP DATA DIVIDE PROVISION SECTION
932
SECOND MAP DATA DIVIDE PROVISION SECTION
950
SELECTION CONTROL ADJUSTMENT PROCESSING SECTION
D219
MAP DATA FOR TRANSMITTING

FIG. 17

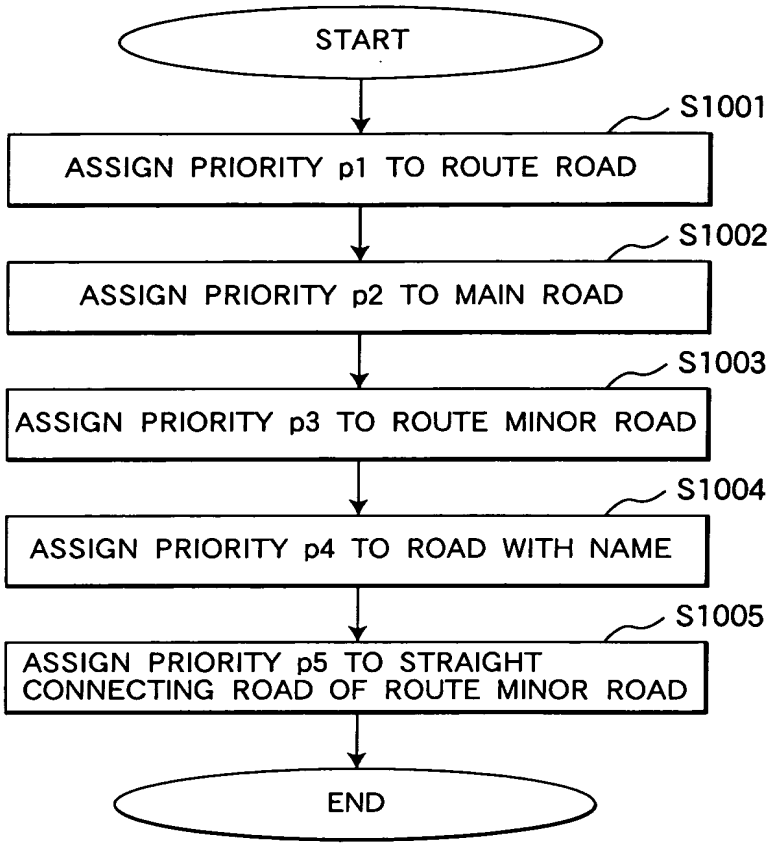


FIG. 18

ROAD DATA WITH PRIORITY

301 1010

ID	LAYER	CATEGORY	FIGURE TYPE	FIGURE DATA	NAME	PRI-ORITY
1001	100	50	polyline	{(x1, y1), ···, (xn, yn)}		p1
1002	100	20	polyline	{(x1, y1), ···, (xn, yn)}	{(name, "ROUTE 20")}	p2
1003	100	20	polyline	{(x1, y1), ···, (xn, yn)}	{(name, "ROUTE 16")}	p3
1004	100	40	polyline	{(x1, y1), ···, (xn, yn)}	{(name, "FUCHU ROAD")}	p4
⋮	⋮	⋮	⋮	⋮	⋮	⋮

FIG. 19A

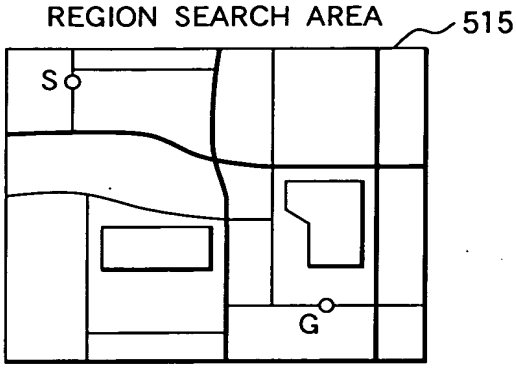


FIG. 19B

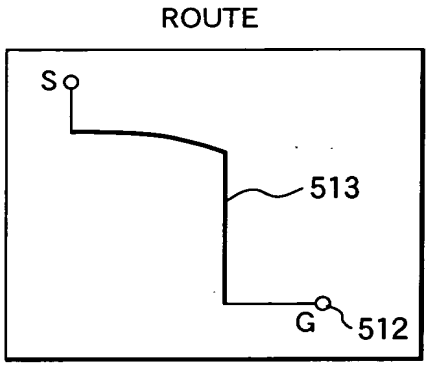


FIG. 19C

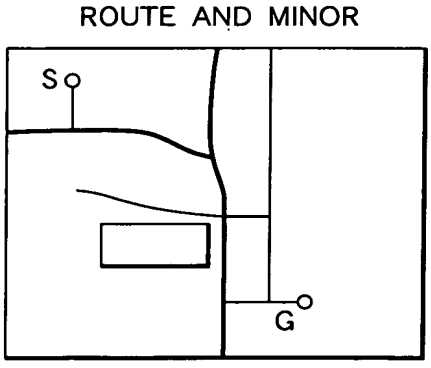


FIG. 19D

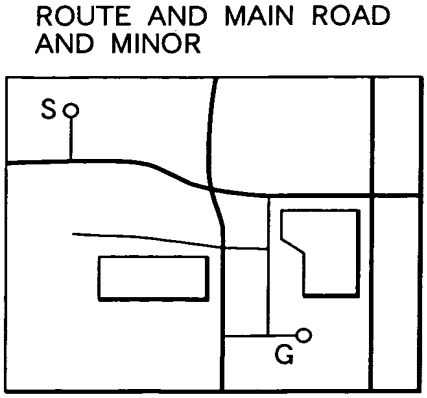


FIG. 19E

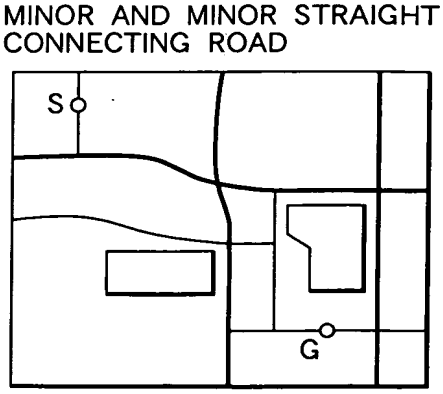


FIG. 20

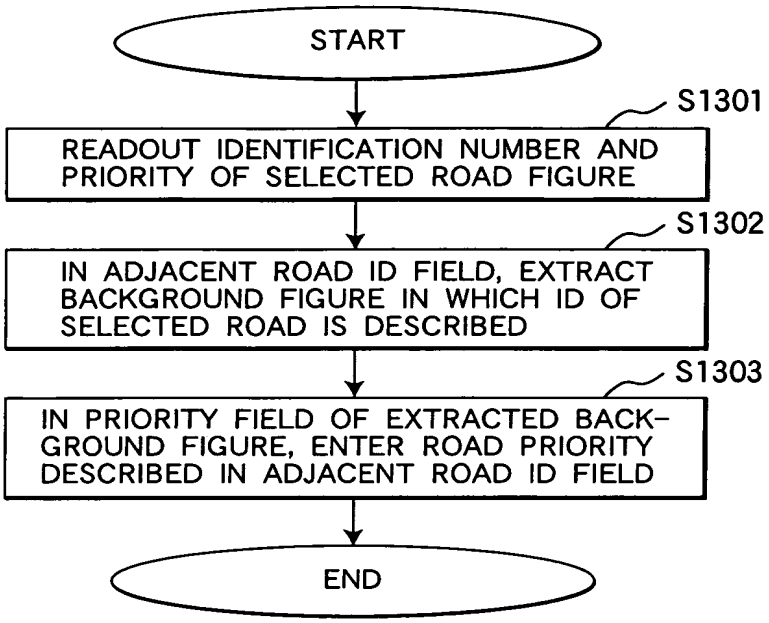

START
S1301
READOUT IDENTIFICATION NUMBER AND PRIORITY OF SELECTED ROAD FIGURE
S1302
IN ADJACENT ROAD ID FIELD, EXTRACT BACKGROUND FIGURE IN WHICH ID OF SELECTED ROAD IS DESCRIBED
S1303
IN PRIORITY FIELD OF EXTRACTED BACK-GROUND FIGURE, ENTER ROAD PRIORITY DESCRIBED IN ADJACENT ROAD ID FIELD
END

FIG. 21

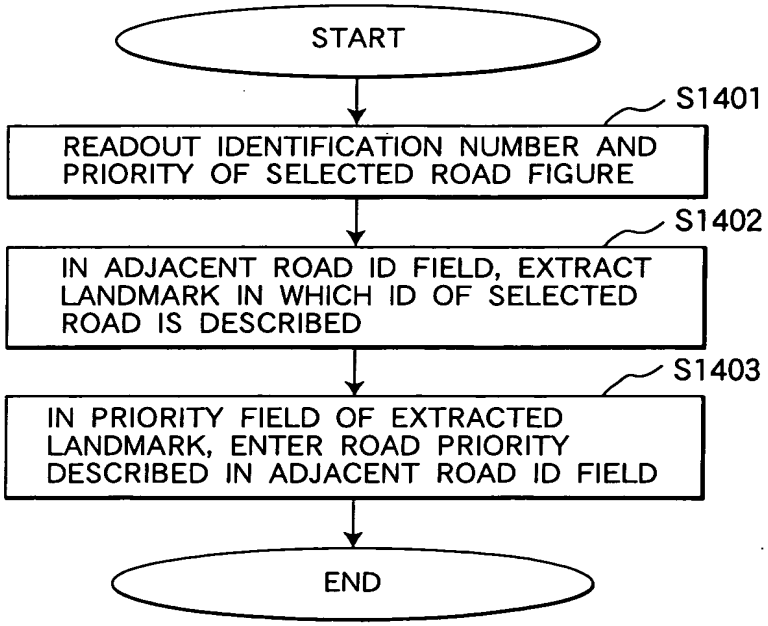

START
S1401
READOUT IDENTIFICATION NUMBER AND PRIORITY OF SELECTED ROAD FIGURE
S1402
IN ADJACENT ROAD ID FIELD, EXTRACT LANDMARK IN WHICH ID OF SELECTED ROAD IS DESCRIBED
S1403
IN PRIORITY FIELD OF EXTRACTED LANDMARK, ENTER ROAD PRIORITY DESCRIBED IN ADJACENT ROAD ID FIELD
END

FIG. 22A

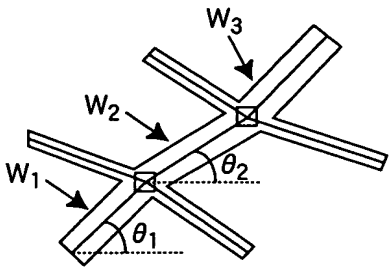


FIG. 22B

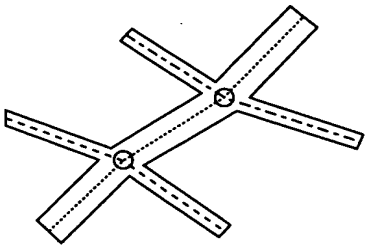


FIG. 22C

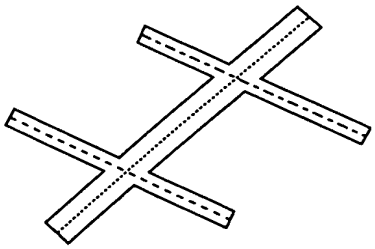


FIG. 23A

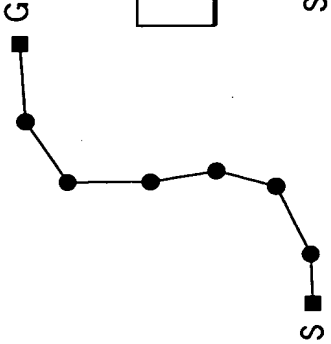


FIG. 23B

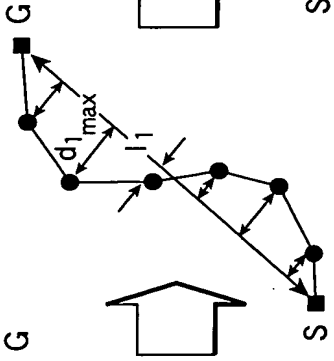


FIG. 23C

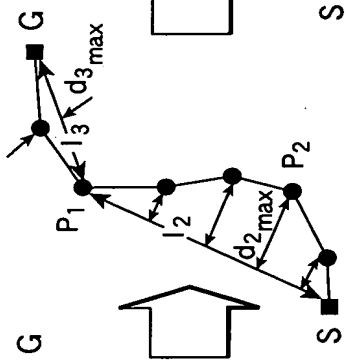


FIG. 23D

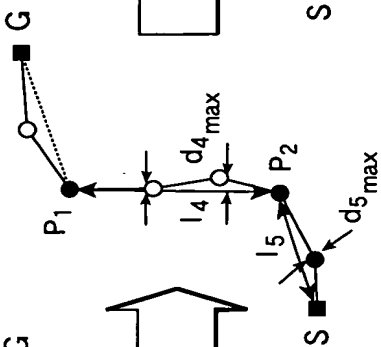


FIG. 23E

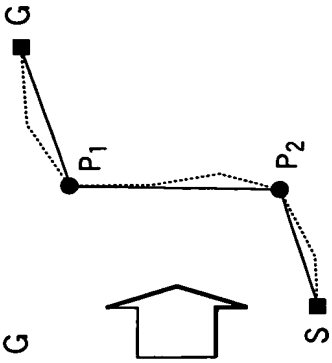


FIG. 24

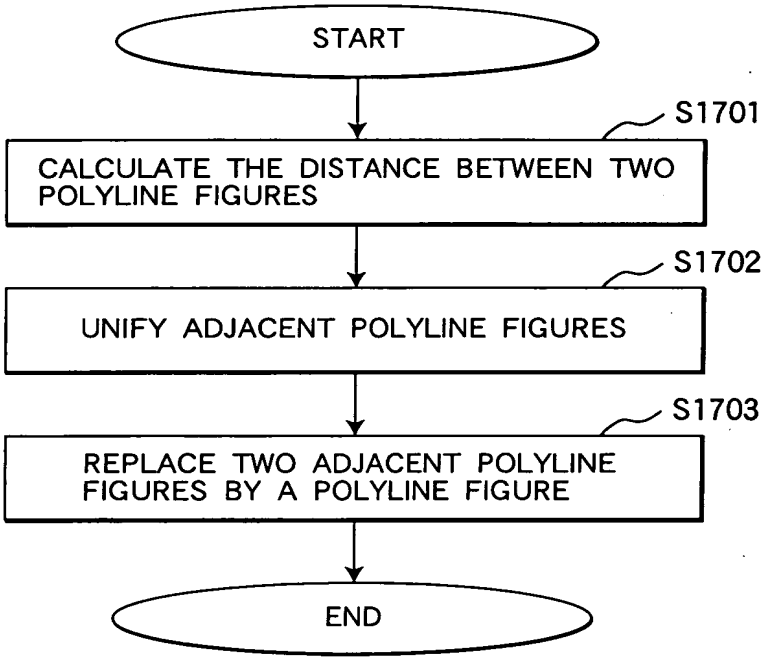

START
S1701
CALCULATE THE DISTANCE BETWEEN TWO POLYLINE FIGURES
S1702
UNIFY ADJACENT POLYLINE FIGURES
S1703
REPLACE TWO ADJACENT POLYLINE FIGURES BY A POLYLINE FIGURE
END

FIG. 25A

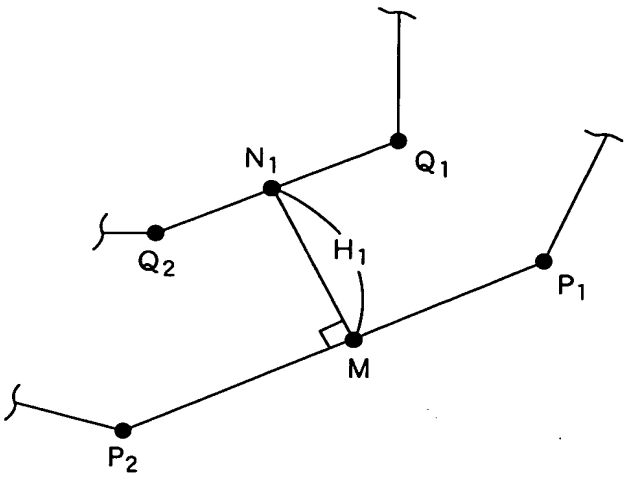


FIG. 25B

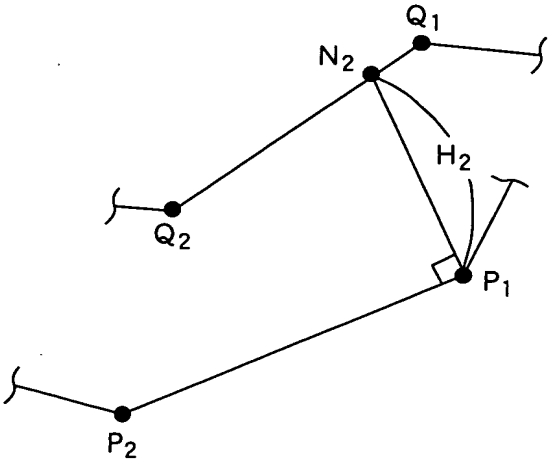


FIG. 26A

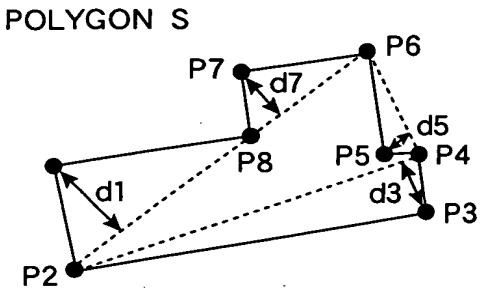


FIG. 26B

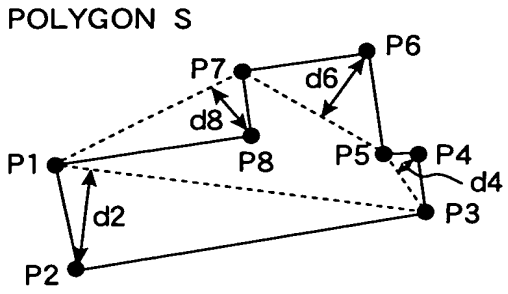


FIG. 27A

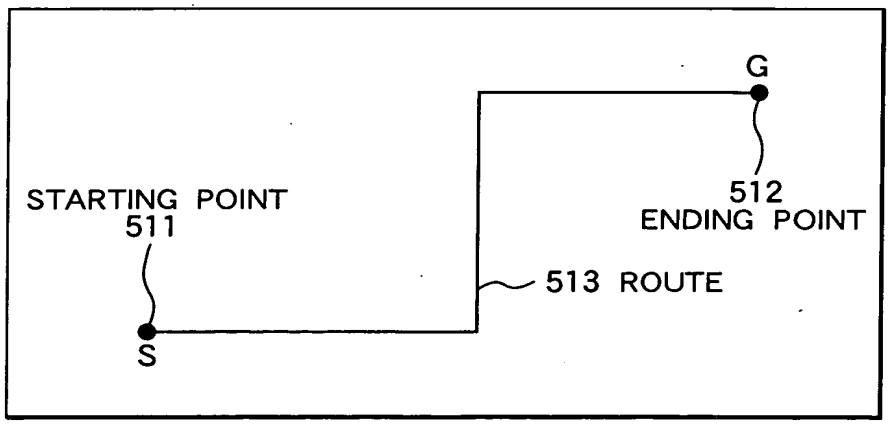


FIG. 27B

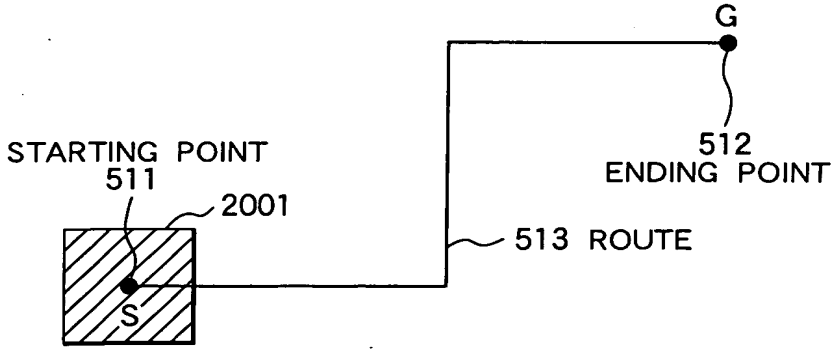


FIG. 28

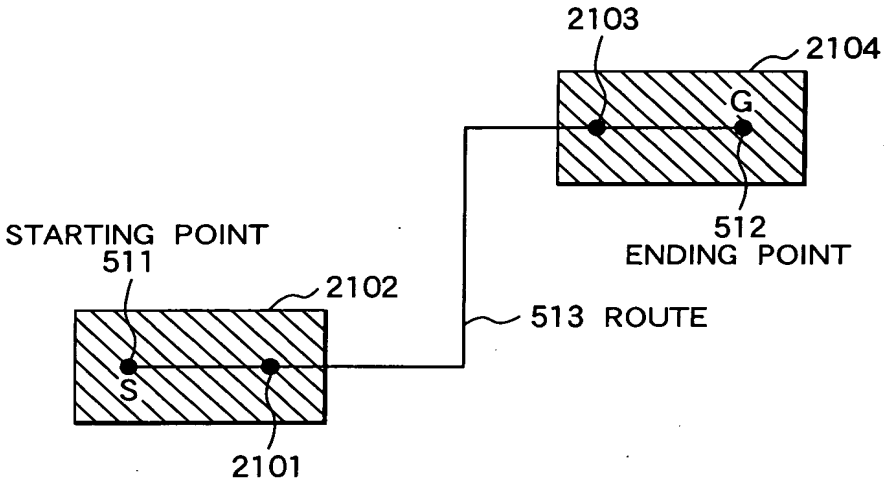

2103
2104
G
512
ENDING POINT
STARTING POINT
511
2102
513 ROUTE
S
2101

FIG. 29A

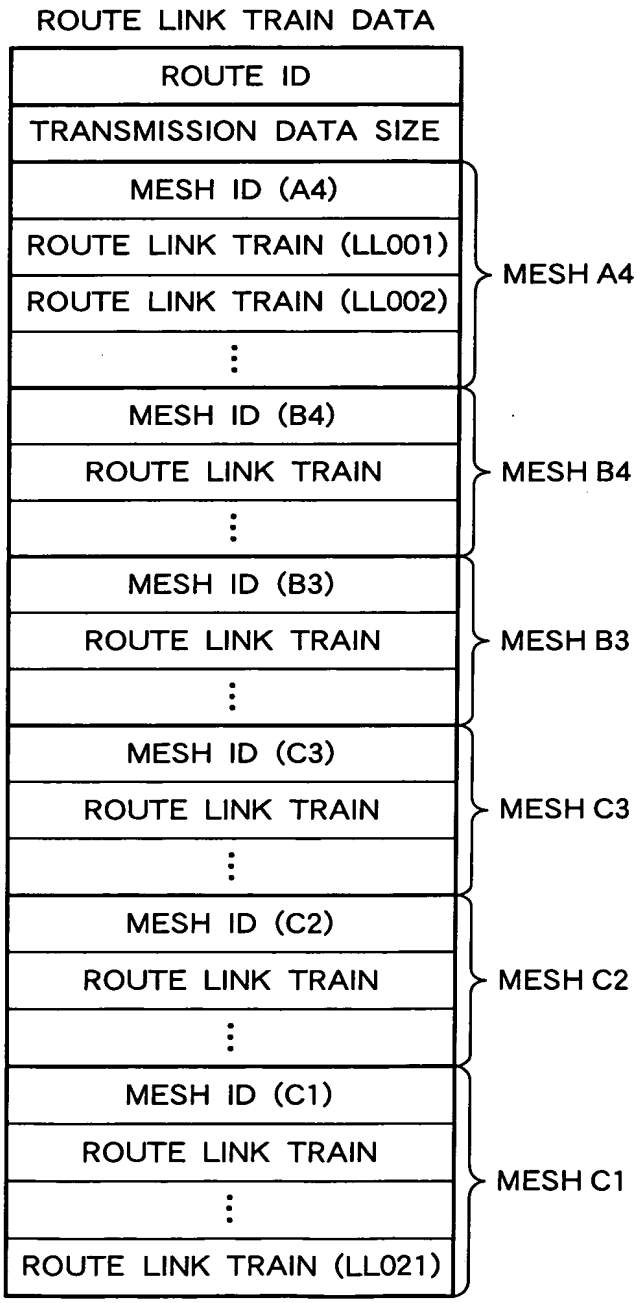


FIG. 29B

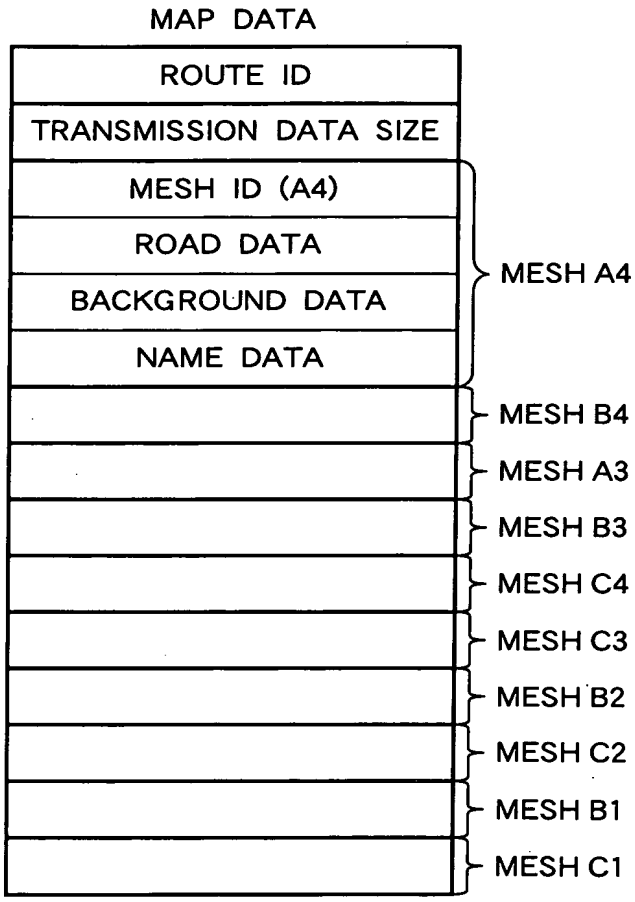


FIG. 30

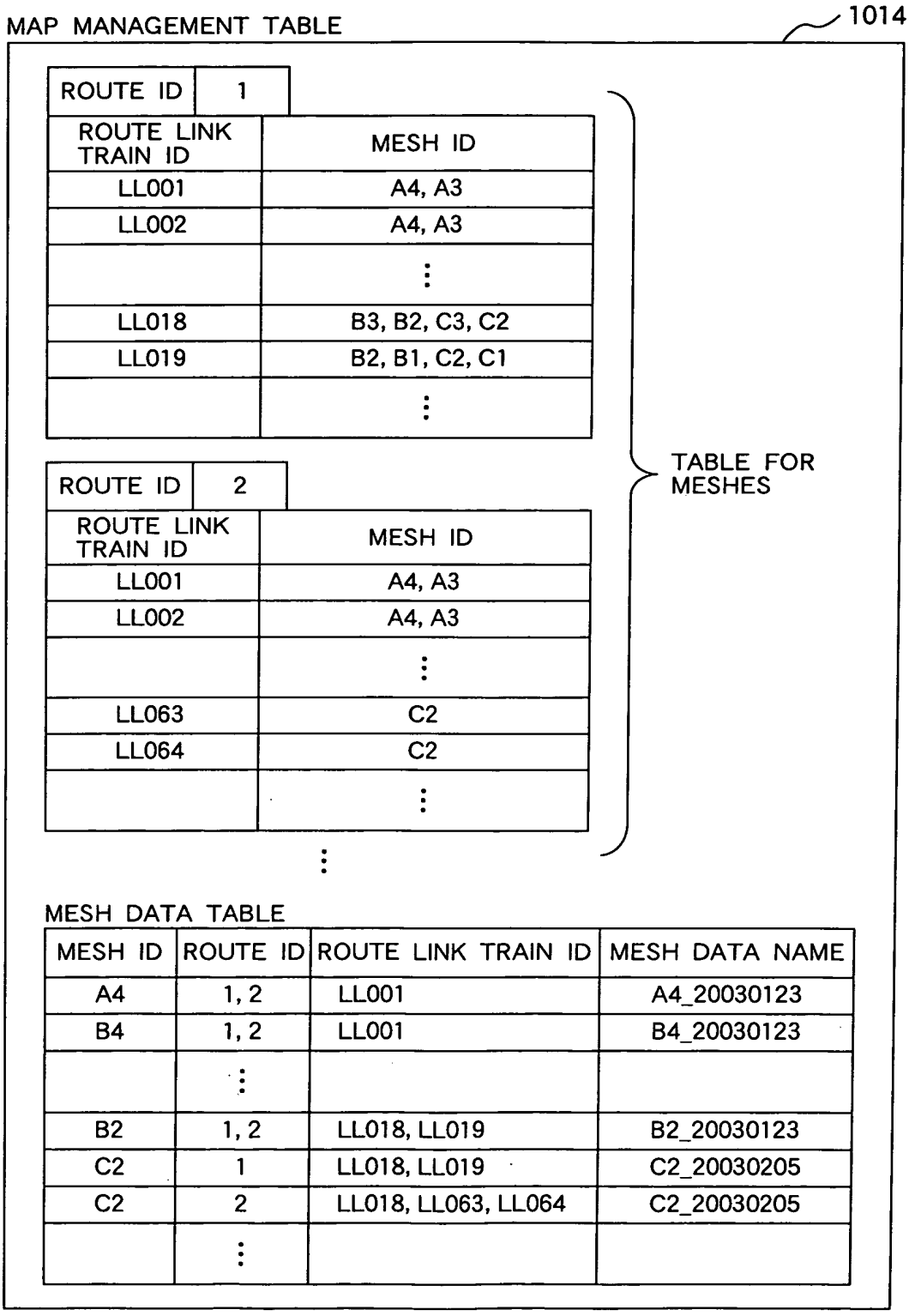

MAP MANAGEMENT TABLE
1014
ROUTE ID 1
ROUTE LINK TRAIN ID
MESH ID
LL001
A4, A3
LL002
A4, A3
LL018
B3, B2, C3, C2
LL019
B2, B1, C2, C1
ROUTE ID 2
ROUTE LINK TRAIN ID
MESH ID
LL001
A4, A3
LL002
A4, A3
LL063
C2
LL064
C2
TABLE FOR MESHES
MESH DATA TABLE
MESH ID
ROUTE ID
ROUTE LINK TRAIN ID
MESH DATA NAME
A4
1, 2
LL001
A4_20030123
B4
1, 2
LL001
B4_20030123
B2
1, 2
LL018, LL019
B2_20030123
C2
1
LL018, LL019
C2_20030205
C2
2
LL018, LL063, LL064
C2_20030205

FIG. 31A

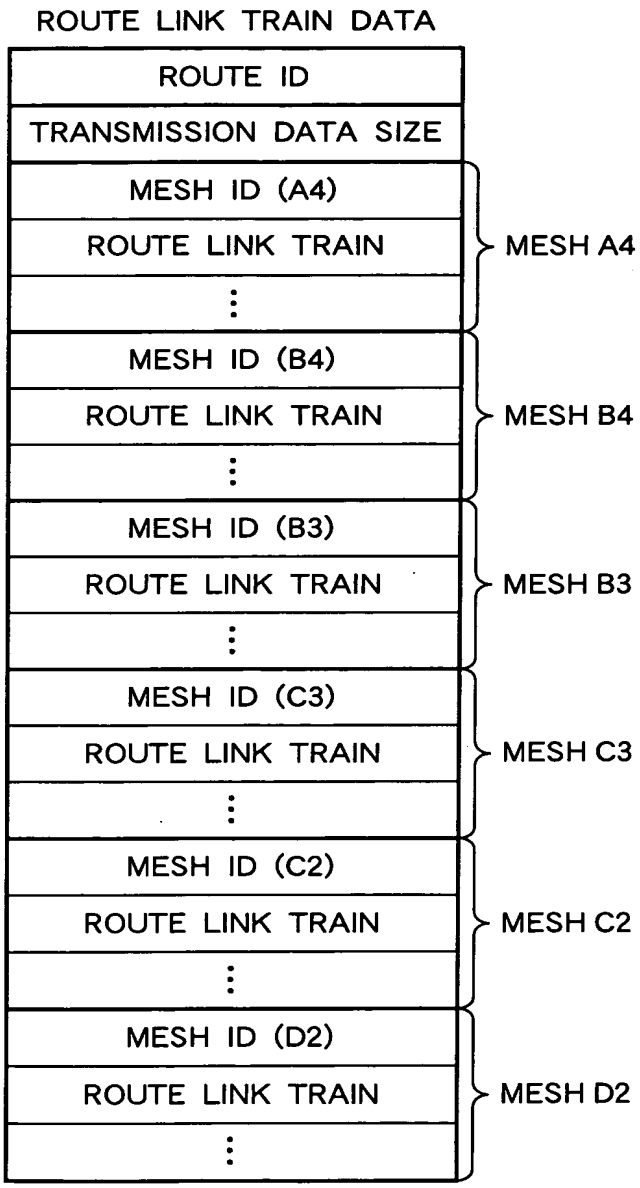


FIG. 31B

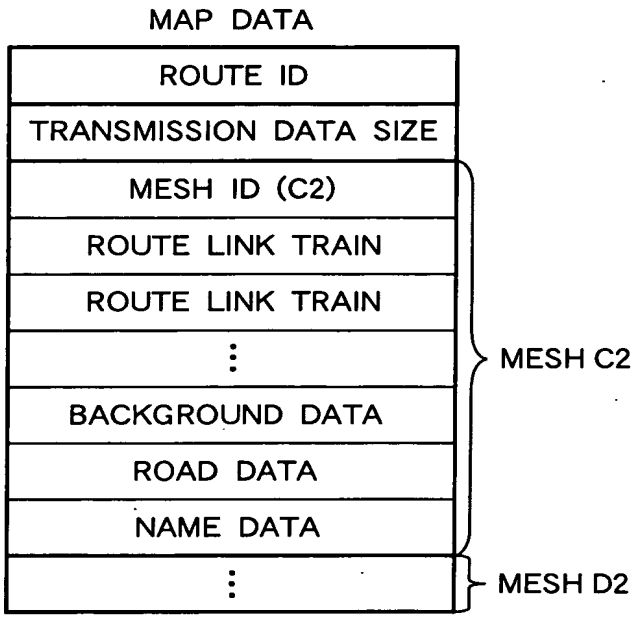


FIG. 32

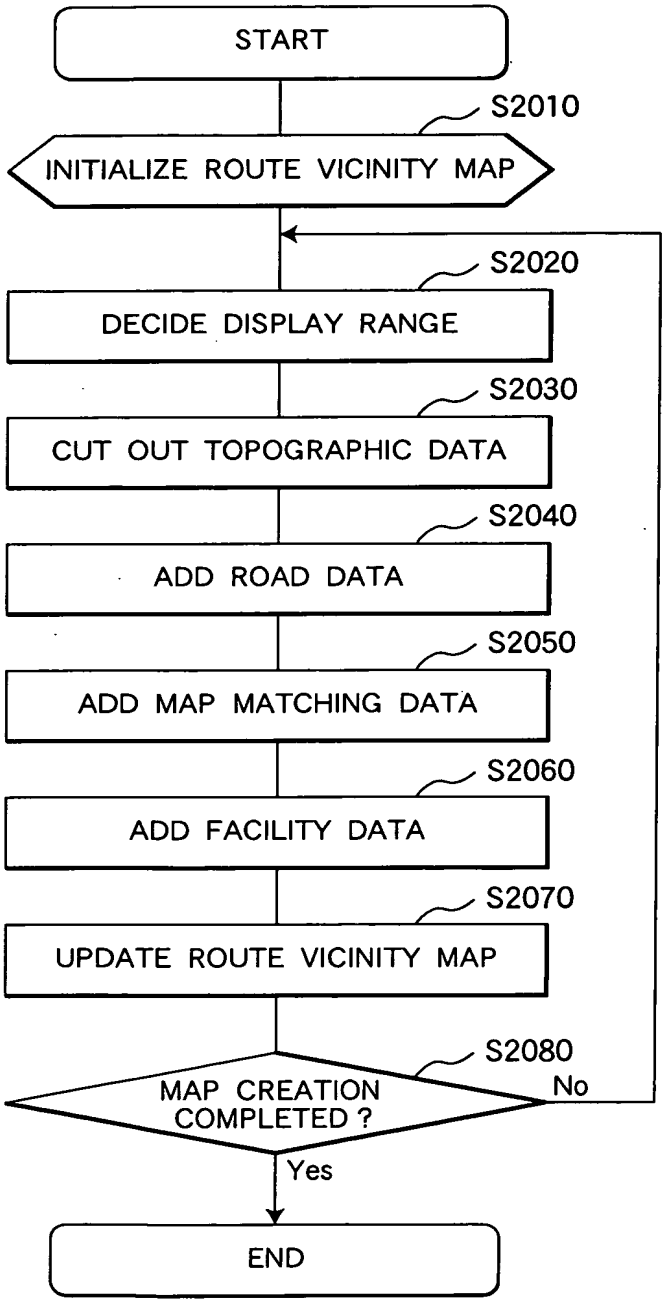

START
S2010
INITIALIZE ROUTE VICINITY MAP
S2020
DECIDE DISPLAY RANGE
S2030
CUT OUT TOPOGRAPHIC DATA
S2040
ADD ROAD DATA
S2050
ADD MAP MATCHING DATA
S2060
ADD FACILITY DATA
S2070
UPDATE ROUTE VICINITY MAP
S2080
MAP CREATION COMPLETED ?
No
Yes
END

FIG. 33

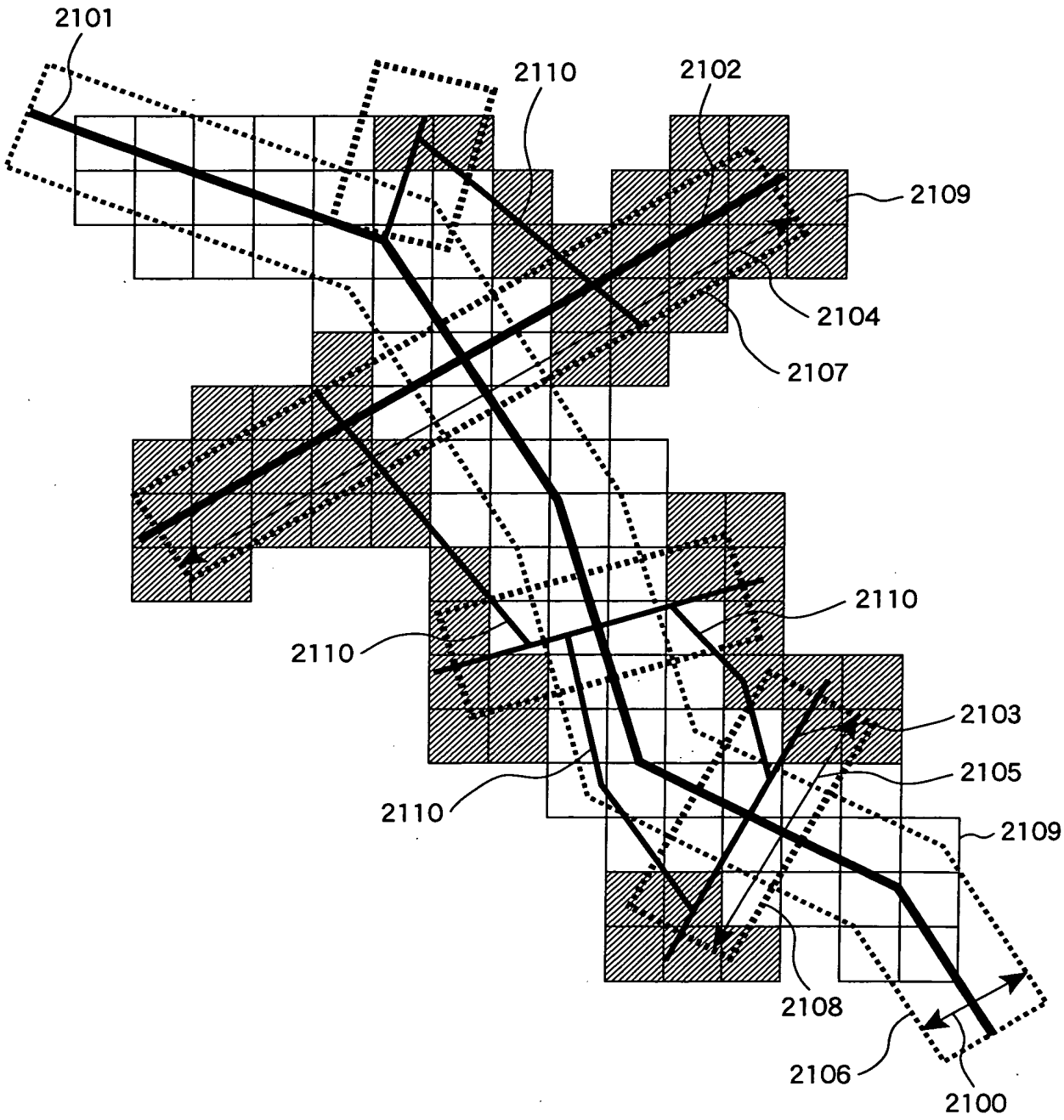
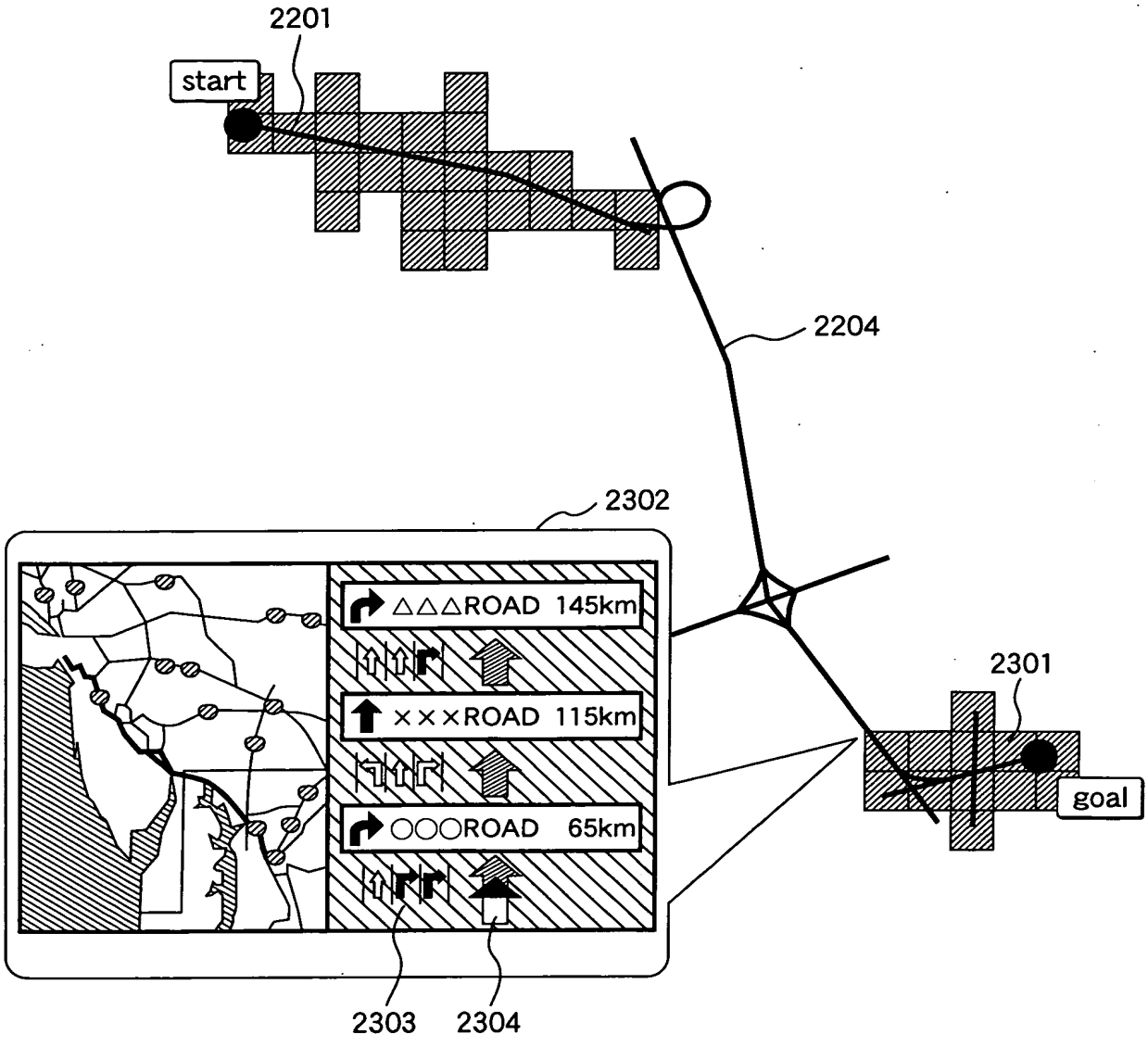

2101
2110
2102
2109
2104
2107
2110
2110
2103
2105
2110
2109
2108
2106
2100

FIG. 34


2201
start
2204
2302
△△△ROAD 145km
×××ROAD 115km
○○○ROAD 65km
2301
goal
2303
2304